

**CLINICAL SCORE CARD FOR  
DIAGNOSIS OF GROUP A  
STREPTOCOCCAL SORE THROAT**

**THESIS**

**FOR**

*DOCTOR OF MEDICINE*

**[PAEDIATRICS]**



**BUNDELKHAND UNIVERSITY  
JHANSI (U.P.)**

**2004**

**VINITA PANDEY**

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*Dedicated to  
My Parents with  
a deep sense of  
respect and love*

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# DEPARTMENT OF PAEDIATRICS

M.L.B. Medical College, Jhansi (U.P.)

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## CERTIFICATE

This is to certify that the work entitled "**CLINICAL SCORE CARD FOR DIAGNOSIS OF GROUP A STREPTOCOCCAL SORE THROAT**" has been carried by Dr. Vinita Pandey in the Department of Pediatrics, M.L.B. Medical College, Jhansi.

She has put necessary stay in the Department as per University regulations.

Dated : 27.1.04

  
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# DEPARTMENT OF PAEDIATRICS

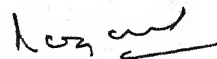
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*Date : 27/01/2004*

*Vinita*  
**DR. VINITA PANDEY**

# CONTENTS

S.NO.	DESCRIPTION	PAGE NO.
1.	INTRODUCTION ...	1 - 6
4.	AIMS AND OBJECTIVES ...	7
2.	REVIEW OF LITERATURE ...	8 - 25
3.	MATERIAL AND METHODS ...	26 - 30
5.	OBSERVATIONS ...	31 - 44
6.	DISCUSSION ...	45 - 64
7.	SUMMARY ...	65 - 68
8.	CONCLUSION ...	69 - 71
9.	BIBLIOGRAPHY ...	72 - 82
10.	WORKING PROFORMA	

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# INTRODUCTION

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# *INTRODUCTION*

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Although steps towards child care and disease were initiated from the beginning of the present century, yet a recognition of the fact that respiratory infections are one of the major cause of childhood mortality and morbidity were brought to light much later. These are described by R.M. Douglas as "Cinderella of communicable disease" upper respiratory infections are among the commonest form of illness. These are one of the major causes of childhood morbidity.

The causal agents are a wide variety of viruses and bacteria, the former being infrequently followed by secondary invasion of the respiratory tract by later (Isaac et al 1982). The same organism may produce different clinical features in different individuals of varying severity.

It is of vital importance to know that though a substantial proportion of upper respiratory tract infection are caused by viral agents, none are vulnerable to the available antibiotics and that the vast majority of children with respiratory infection will recover more safely without their use. At the same time the use of antibiotics has enormously reduced the mortality and morbidity from respiratory illness in children when they are bacterial in origin.

Among the bacteria causing pharyngitis and tonsillitis, the most important are group A streptococci, which mostly infect school age children of lower socio-economic status.

The public health importance of streptococcus pyogenes (group A streptococcus) lies not only in its frequency but in the fact that it is a precursor of two serious non suppurative sequels viz acute rheumatic fever and post streptococcal glomerulonephritis. The peak incidence of streptococcal pharyngitis is in children aged 5-15 years and it accounts for 15-20% or more of cases of acute pharyngitis in the this group.

Although most cases of acute pharyngitis are self limited, there are valid reasons for attempting to establish or exclude certain diagnosis. In the great majority of instances, however, the pertinent clinical issue is the differentiation of Group A streptococcal (GAS) infection from Non group A Streptococcal causes. The former requires appropriate antimicrobial therapy to prevent acute rheumatic fever and suppurative complications, minimize the possibility of secondary spread, and truncate the cause of illness, if administered early.

Incidence of group A streptococcal pharyngitis is lowest among infants. Streptococcal pharyngitis is most common in temperate climate and cold weather. Streptococcal pharyngitis in children older

than 2 years may begin with non specific complaints of headache, abdominal pain and vomiting, fever  $48^{\circ}\text{C}$  ( $104^{\circ}\text{F}$ ), hours after the initial complaint throat may become sore. The incubation period may range from 2-4 day.

Group A Streptococci are gram positive cocci and are normal inhabitants of the oropharynx; colonization rates in children vary from 15-20%. The incidence of disease depends on the age of the child, the season of the year, the climate and geographic location, and the degree of contact with infected individuals.

The  $\beta$ -haemolytic streptococci were classified by Rebecca Lancefield (1933) serologically into groups based on the nature of carbohydrate (C) antigen of cell wall<sup>19</sup>. Lancefield groups have been identified so far and named "A-U" (without I and J). The great majority of haemolytic streptococci that produce human infections belong to group A, which is also known as streptococcus pyogenes. These may be further subdivided into types based on the protein (M, T and R) antigens present on cell surface (Griffith typing) About 80 M protein types of streptococcus pyogenes have been recognized so far (Paniker, 1994).

The primary site of invasion of the human body by streptococcus pyogenes is the throat. Sore throat is the commonest of streptococcal diseases. Tonsillitis is common in older children and diffuse pharyngitis in younger children. Pharyngitis is mainly caused by group A, though sporadic cases and epidemics have been reported due to group C and G. Rheumatic fever may occur in upto 3% of individuals during epidemic pharyngitis.

Acute rheumatic fever and acute glomerulonephritis : These complications ensue 1-3 weeks after acute infection so that the organism is no longer detectable when sequelae set in. Rheumatic fever may follow infection with any serotype of streptococcus pyogenes, but M types 1,3,5,6,18,24 are more frequently isolated, nephritis is caused by only a few nephrogenic strains. The epidemiology of acute rheumatic fever is essentially the epidemiology of Group A streptococcal pharyngitis. The latent period usually 1-3 weeks between the onset of the actual group A streptococcal infection and the onset of symptoms of acute rheumatic fever, tends support to an immunologic mechanism of tissue damage.

The acute infections diagnosis is established by culture. For culture swab should be collected under vision from the affected side.

Sheep blood agar is recommended for primary isolation because it is inhibitory for *Haemophilus haemolyticus*. A convenient method for the identification of *Streptococcus pyogenes* is based on Maxted's observation that they are more sensitive to bacitracin than other streptococci. Bacitracin sensitive colonies can be confirmed further by coagglutination test.

In rheumatic fever and glomerulonephritis, a retrospective diagnosis of streptococcal infection may be established by demonstrating high levels of antibody to streptococcal toxins ASO titres higher than 160 or 200 Todd units are indicators of prior streptococcal infection.

Appropriate diagnosis and treatment of group A streptococcal pharyngitis is important for prevention of rheumatic fever and rheumatic heart disease though throat culture is recommended for confirmation of group A streptococcal infection. In primary care clinics, widespread use of throat cultures cannot be practiced, as laboratory facilities are not available. Though rapid diagnostic kits have been developed, use of a rapid diagnostic kit in a developing country like India is not a cost effective approach. To overcome these problems, attempts have been made to develop scoring systems for the

differentiation of streptococcal and non group A streptococcal sore throat. This study was planned to test the validity of a clinical scoring system for the diagnosis of group A streptococcal sore throat in community setting.

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# *AIMS AND OBJECTIVES*

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## *AIMS AND OBJECTIVES*

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- 1) To find out the incidence of Group A streptococcal infection in children with various signs and symptoms of sore throat in hospital setting :-
  - i) Throat swab culture.
  - ii) Presumptive confirmation of  $\beta$ -hemolytic colonies as group A streptococcal by bacitracin sensitivity.
  - iii) Final confirmation of bacitracin sensitive colonies as Group A streptococcal by specific coagglutination test.

To validate a clinical scoring system for diagnosis of Group A streptococcal infection.

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*REVIEW OF  
LITERATURE*

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# REVIEW OF LITERATURE

## HISTORICAL

In traditional taxonomic schemes the streptococci belong to the family streptococcae. These organism are gram positive, catalase-negative bacteria that tend to grow in pairs and chains.

Cocci in chains were first seen in erysipelas and wound infections by Billroth (1874) who called them streptococci Ogston (1881) isolated them from acute abscesses, distinguished them from staphylococci. Rosenbach (1884) isolated the cocci from human suppurative lesions and gave the name streptococcus pyogenes. Haemolysis was first proposed as a criteria for classification by Schottmuller (1903). Employing neat infusion peptone agar and 5% horse blood Brown (1919) recognized three types of reactions-

$\alpha$ -haemolytic streptococci produce a greenish discoloration with partial haemolysis around the colonies. The zone of lysis is 1 or 2 mm wide with indefinite margins and unlysed erythrocytes can be made out microscopically within this zone.  $\beta$ -haemolytic streptococci produce a sharply defined, clear colourless zone of haemolysis 2-4 mm wide, within which red cells are completely lysed. (3) Gamma ( $\gamma$ ) or non haemolytic streptococci produce no change in the medium. The

pioneering work of Rebecca Lancefield established the Lancefield grouping system for the  $\beta$ - hemolytic streptococci. Twenty streptococcal groups A through H and K through V have been identified so far (Nelson text book of pediatrics).

In Group A streptococci, the cell wall is composed of three distinct layers. The outer portion contains several antigenic proteins; the most important is M protein. Group A  $\beta$ -hemolytic streptococci can be divided into more than 80 immunologically distinct types based on differences in the M protein. M antigen appears to be the major virulence factor having a role in attachment to epithelial cells and resistance to phagocytosis. Lipoteichoic acid, another cell wall constituent is another virulence factor that promotes colonization by binding to fibronectin on the surface of epithelial cells. The hyaluronic acid capsule resists phagocytosis, further facilitating virulence. Acquired immunity is directed at the M protein.

Streptococci elaborate toxins, enzymes and hemolysins. The extracellular product of greatest clinical significance are pyrogenic exotoxins (A,B & C), streptolysin O, streptolysin S, streptokinases, deoxyribonuclease, hyaluronidase and proteinase. Streptolysin S is largely cell bound and damages the membranes of neutrophils and platelets. Streptolysin O is produced by most

group A and some group G streptococci. It lyses red blood cells and is toxic to neutrophils, platelets and mammalian heart muscle. Elaboration of streptolysin S and O produces the clear zone of hemolysis. Streptokinase lyses fibrin, DNase B helps liquefy pus and hyaluronidase breaks down ground substance.

### **INCIDENCE OF RESPIRATORY TRACT INFECTION**

Before the introduction of antimicrobial agents, systemic streptococcal infections, including scarlet fever, puerperal sepsis and bacteremic disease, were frequently fatal and non suppurative complications including rheumatic fever and nephritis were life threatening. Death was the usual outcome for invasive disease caused by group A streptococcus in the preantibiotic era; Keefer et al (1937) reported a mortality rate of 72% in patients with group A streptococcal bacterimia. The patients included children with foci of infection or throat and middle ear, women with puerperal infection and older patients with post-operative infections and underlying diseases such as diabetes and arteriosclerosis. The clustery of military personnel in crowded quarters during and after world war II resulted in epidemic streptococcal infections. Rheumatic fever was diagnosed in 21000 Naval personnel alone and the disease was widespread in army camps. Investigators at the streptococcal Disease Laboratory at Fort Warren, WY demonstrated efficacy in

prevention of rheumatic fever of a regimen of intramuscular procaine penicillin in peanut oil administered on days 0 and 3.

Gletzen et al (1985) claim that mycoplasma species may cause a pharyngitis which cannot be distinguished from a streptococcal tonsillitis or pharyngitis. Beta hemolytic streptococci non group A have also been considered to cause tonsillitis with the same clinical picture and cause as group A streptococci. A streptococcal etiology, usually group A streptococci, has been found in between 25 and 70% of cases.

Mathur NB, 1991 found that there are more than 225 pathogens including more than 200 viruses which are currently known to cause upper respiratory infection.

According to guidelines provided by Infectious Disease Society of America (1997) viruses are the most common non bacterial causes of acute pharyngitis. Respiratory viruses such as adenovirus, parainfluenza virus, rhinovirus, and respiratory syncytial virus are frequent causes. Other viral agents of acute pharyngitis include coxsackie virus and ECHO viruses as well as herpes simplex virus. Epstein Barr virus is a frequent cause of acute pharyngitis that is often accompanied by other clinical features of infectious mononucleosis. Systemic infections with measles virus, cytomegalovirus, rubella virus, influenza virus may be associated with acute pharyngitis. Mycoplasma and

chlamydia are uncommon causes of acute pharyngitis. The group A  $\beta$ -hemolytic streptococci are the most common cause of bacterial pharyngitis, but other bacteria are also capable of producing acute pharyngitis. These include group C and G  $\beta$ -hemolytic streptococci and *C. diphtheriae*, *Arcanobacterum*, *N. Gonorrhoea*, *Francisella* and *Yersinia* are rare causes of acute pharyngitis.

A more recently recognized viral cause of acute pharyngitis is the acute retroviral syndrome occurring in some patients during primary infection with human immunodeficiency virus. Acute pharyngitis is generally caused by viruses. Group A  $\beta$ -hemolytic streptococcus is the only common bacterial causative agent and, except during epidemics, it accounts for probably fewer than 15% of cases (Nelson Textbook of Pediatrics).

In their study Dobbs F (1996) found that 5-40% of case of sore throat result from group A beta -hemolytic streptococci.

Nandi et al in their study on 536 children 5-15 years suffering from gala kharab (bad throat) and khansi jukam (cough and cold) found incidence of sore throat and Group A streptococcal sore throat respectively 7.05 and 0.95 episodes per child year. The incidence was higher among 11 year olds, during the winter (November to January) and Rainy (August) months (a bimodal peak), and those living in over crowded condition

exposed to kitchen smoke and tobacco smoke. 13% of throat swabs were group A streptococcal culture positive.

In India isolation rates of group A streptococcus in children with pharyngitis have ranged from 4.2% to 13.7% (Bulletin of the WHO, 2001).

In southern India 12% of all pharyngitis cases were caused by group A streptococcus) Koshi G et al 1970).

Rotta J and Tikhomurov E (1987) in prospective studies have disclosed that in temperate climates 20% or more of individuals may be harbouring hemolytic streptococci. The incidence of streptococcal acute upper respiratory tract disease in temperate zone is 5-15 case/1000 year. In India prevalence of rheumatic heart disease in children has been estimated at between 2 and 10 per 1000. As 43% of the population are under 14 yrs old, some three million children could be suffering from rheumatic heart disease in this country. Microbiological confirmation of clinical disease is essential but it requires at least one or two day. The new rapid direct (non culture) techniques for identification of Group A streptococci in clinical specimen represent a real break through. In general prevalence of rheumatic heart disease in developed countries is 0.1/1000 and 1-22/1000 in developing countries.

Sarkar S et al (1998) in a study on sore throat and  $\beta$ -hemolytic streptococcal pharyngitis among rural school children in Varanasi with reference to age and season had found that the point prevalence of Group A streptococcal sore throat was 13.6%.

Gupta et al (1992) in a study in Delhi found the prevalence of Group A streptococcal pharyngitis 13.7%.

Gandhi et al (1962) carried out a study on morbidity and mortality in children. System wise analysis proved that respiratory communicable, gastrointestinal, central nervous system disease accounted for 69.74% of total morbidity and 8.90% total mortality. Disease of respiratory system form the biggest group constituting 18.9% of total admission.

Udani (1963) conducted a study on morbidity in two city hospitals in Bombay, India. He found that cases of gastroenteritis and respiratory system were predominant comprising 18.50% of each. In later, upper respiratory infections were 30%.

Prasad et al (1958) while surveying child health in a rural community in South India found that upper respiratory infections, gastroenteritis and skin disease were the major causes of morbidity.

Dutta et al (1969) concluded from his study that respiratory and gastrointestinal disease together accounted for 76.7% of total episodes of diseases, respiratory disease 49.6% and gastrointestinal disease 27.1%.

Hitze et al (1978) reported that even mild upper respiratory infections may account for a considerable number of lost working days.

Verma et al (1960), reported that in India, respiratory tract infections are most common cause of morbidity and mortality after diarrhea. In these respiratory infections about 80% morbidity is due to upper respiratory infections.

Viral, bacterial and fungal causal agents play various roles according to age, immunological status of populations and degree of exposure of the individual. In developing countries the incidence of viral URI is upto 50%.

Many antecedent viral infections seems to play an important role in the invasion of the human host by bacterial pathogens present in the oropharynx by impairing a child immune status. But Oizunik et al (1989) in their study found no such correlation between viral infections and secondary bacterial infections.

Group A streptococci are the most common bacterial cause of acute pharyngitis (Prakash et al, 1973) Streptococcal pharyngitis is most common between 6-12 years of age and severity appear to increase in cold weather, spread is by personal contact and droplets. In children under six months of age it causes thin nasal discharge, 6 months to three years it causes naso pharyngitis, lymphadenopathy. Otitismedia and sinusitis. In older children it causes tonsillitis or pharyngitis (Breese BB et al, 1960).

***Percentage of throat culture positivity :-***

Koshi et al (1977) conducted a study on school children suffering from URTT. They found that 28.8% of children were positive for beta hemolytic streptococci in their throat.

Agarwal et al (1981) found that overall rate of streptococcal throat infection was 15.9%. Tonsillitis (44.2%) and pharyngitis (37.5%) were found more commonly associated with positive culture as compared to condition like sore throat (19.6%).

Kaplan et al (1989), found that 26% of the children suffering from upper respiratory infections were positive for group A streptococci in their throat.

Marchisio et al (1987) found that 36% of children suffering from upper respiratory tract infection had throat swab culture positivity for group A streptococcus.

### **AGE**

Cauwehberge and Miynsbrugge (1991) in a survey of microbiological etiology of pharyngitis reported age to be an important factor.

Forst et al (1953) have shown that maximum incidence of respiratory tract infection is in the 5<sup>th</sup> and 6<sup>th</sup> year of life and with advancing age child develops more resistance to infections.

Fry et al (1957) found highest incidence of coryza, tonsillitis and otitis media at 5-6 years of age.

Priablesen (1958) observed that maximum incidence of cold and catarrh was during 0-4 years of age while of sore throat at 10-12 years.

### **SEX**

Malhotra et al (1966) found no difference in incidence of respiratory infection between male and female children. This is in agreement with the observation of U.S. National Health Survey (1959) but differ from report of Chaudhari and Chaudhari (1962) who quoted higher morbidity rate among female children.

Gulati (1967) reported that it was found in hospital studies that attendance of male preschool children in hospital was higher than that of females, thus indicating that the illness in male children was taken more seriously than that in females.

Study by Anderson in 1986 analysed results from morbidity statistics from general practice 1970-71, which show respiratory infections as percentage of all condition in general practice. Episodes per 1000 are 36% in males and 35% in females between age group 0-4 years and 35% males and 34% females in age groups 5-12 years.

Narain et al (1987) found that respiratory infection tend to affect more frequently male than female. The ratio is about 1.7 to 1. The difference may partly be due to preferential treatment to male children who when sick are more likely to be brought to hospital.

### **NUTRITION**

A study conducted by Gupta et al (1977) demonstrated that malnourished children suffer from larger number of episode of respiratory infections and illness days suffered due to respiratory disease. In malnourished children and normal children it is significant (2.8 episodes Vs 2.1 episodes and 14.7 day Vs 8 days).

## **SEASON**

A study by Gulati et al (1963) shows the expected increase in incidence of respiratory disease during the winter months.

Report from scientific group of WHO in 1979 reported that in developed countries respiratory infections usually occur more frequently in cold winter than in summer.

Kerr et al (1979) noticed that increased exposure of indoor living is also a factor that increases risk during winter.

Verma et al (1981) found that the incidence of respiratory disease increases during winter months.

## **POLLUTION**

Sofoluve et al (1968) have reported an increased incidence of respiratory infection among children who have been exposed to smoke from burning firewood.

## **OVERCROWDING**

Gupta et al (1963) documented that larger the family greater the attack rate.

## **SCORING SYSTEM**

Scoring or similar systems for diagnosis or measurements of the clinical condition of patients are not new. One of the best known is the apgar score used as a measure of newborns condition. In the streptococcal field Schneider and his colleagues at Lowry Air Force Base used a scoring system as an aid in determining if a given patient fulfilled sufficient criteria of streptococcal illness. Similar scoring system was used by Randolph. If such scoring systems are reasonable, can serve the following purposes.

- 1) They give the clinician a quick, simple and inexpensive tool for checking the tentative clinical diagnosis.
- 2) They indicate, as Randolph et al have suggested, those patients with respiratory infection in whom cultures for hemolytic streptococci can be omitted with reasonable safety.
- 3) They suggested the existence of carrier state in patients with low score and positive cultures.
- 4) They suggest the possibility of laboratory error in those with high scores and negative cultures.
- 5) They can be of considerable value when physicians are in short supply (Breese 1977).

In 1961, Stillerman and Bernstein stated "If you are entirely comfortable selecting which pharyngitis patients to treat 10 days with penicillin, perhaps you don't understand the infection". Although this infection has been studied continuously, our understanding of who needs to be treated remains inaccurate. Group A  $\beta$ -hemolytic streptococcus is a major treatable cause of pharyngitis and resurgence of rheumatic fever as a sequel to this infection points to importance of accurate diagnosis and treatment of this elusive infection.

Breese et al (1977) reported that based on a number of clinical signs and symptoms we could predict the results of cultures for  $\beta$ -hemolytic streptococci in such children with about 75% accuracy. They devised a nine factor score card for diagnosis of group A streptococcal sore throat.

Nine factors were (1) month in which the patients was seen, (2) age, (3) WBC count, (4) fever, (5) sore throat, (6) cough, (7) headache, (8) abnormal pharynx and (9) abnormal cervical lymph nodes. Scores were obtained by taking the percentage of positive streptococcal cultures found by study to be associated with the presence or absence of any given factor, dividing this percentage by ten, and rounding it to

the nearest digit. For those nine factors the highest score possible was 38 and the lowest 14.

Rules for scoring system had been established (1) for a symptom or sign to be listed as "yes", it should have developed concurrently with the onset of the present illness (2). The presence of moderate or intense redness or swelling, exudate (especially if a yellow, sometimes blood tinged swab was obtained), petechial, dough nut lesions or ulceration of the throat was always listed as abnormal. (3) the abnormal cervical glands were the submandibular or anterior cervical lymph nodes that drain the tonsillar area. They were considered abnormal only if they were very enlarged without tenderness or if they were palpable and tender.

The score at which or above which more than 50% of the population had positive cultures was 30. There were 42.1% of the patients with scores below this point and their mean percent of positive culture was 22%.

In the remaining 57.9% of the population with scores at or above 30, the mean percent of positive cultures was 77.6%. On the basis of these scores and related percent of positive cultures, patients were divided into four groups- "No", "May be No", "Yes" and "May be

Yes". Scores associated with less than 50% of cultures positive for  $\beta$ -hemolytic streptococci were assigned the diagnosis of "No" or "May be No". Scores associated with greater than 50% of positive culture were assigned the diagnosis of "Yes" and "May be Yes".

The scoring system by Breese showed 83% sensitivity 72% specificity and both positive and negative predictive value of 78%.

In the study of Reed et al (1990) cultures for group A  $\beta$ -hemolytic streptococcus were performed in 806 patients presenting with sore throat. The directigen 1-2-3 group A streptococcal test had a sensitivity of 67%, a specificity of 85% a positive predictive value of 61%. The scoring system had a sensitivity of 26%, a specificity of 94% a negative predictive value of 79%. Neither directigen group A streptococcal test or clinical score can replace culture in the diagnosis of group A  $\beta$ -hemolytic streptococcal pharyngitis.

The use of directigen Group A streptococcal test resulted in lower rates of delayed treatment but higher rates of unnecessary treatment and higher costs. The use of the clinical score resulted in less over treatment because of its greater specificity but failed to identify 74% of those with group A  $\beta$ -hemolytic streptococcus in the pharynx.

Dobbs (1996) studied sore throat patients aged 4 year more who had not taken antibiotic in the previous 2 week. Occurrence rates for each data item in the group with infection and the group without infection were calculated and differences between the two groups were tested for significance using the chi-square test.

Bayesian probability scores (B-scores) were then calculated using the method of Dobbs & Fleming. The streptococcal throat B-score system predicted positive culture with a sensitivity of 71% and a specificity of 71%. In comparison unaided general practitioner predicted infection with a sensitivity of 61% and specificity of 65%.

Komaroff et al (1986) devised a 7 factor score for prediction of the occurrence of an immunologically significant episodes of group A streptococcal pharyngitis. They assigned positive points for marked tonsillar exudates, enlarged tonsil, tender anterior cervical lymphadenopathy myalgias and positive throat culture in preceding year. A negative score was assigned for presence of itchy eyes.

Nandi et al (2002) validated a 8 factor scoring system including two epidemiological factor, four clinical signs and two symptoms. Clinical score of 15 or more was used to predict Group A streptococcal infection. 13.4% of throat swabs were group A streptococcal culture

positive. Among males and females positivity was 14.7% and 11.7% respectively. Most common symptoms of group A streptococcal sore throat was pain in throat 86.2% and major signs were erythema of pharynx 92.7%, enlarged tonsil 87.9%, lymphadenopathy 87%. Of the 10 symptoms and signs tested pain in throat had highest sensitivity, specificity and negative predictive value. The sensitivity of this system was 91%, specificity 98% and negative predictive value 98.4%. However positive predictive value of the score system was low 48.5% which depends on group A streptococcal prevalence in community.

Group specific antibodies adsorbed to protein A containing staphylococci have recently become commercially available for grouping streptococci of groups A,B,C,G (Roger et al, 1977).

Group B Streptococci gave the strongest and most rapid degree of coagglutination and group G streptococci. The weakest and slowest cross agglutination occurred in 7.3% of the group able streptococci. However this did not give result to problem of interpretation. Ruden et al (1987) studied coagglutination method the results of which were available in five minutes. The reliability and reproducibility of this method has been confirmed by WHO.

## MATERIAL AND METHODS

The present study was carried out in the Department of Paediatrics in collaboration with Department of microbiology, M.L.B. Medical College, Jhansi.

### Selection of cases

Children in 5-12 yrs age group of either sex attending OPD or admitted in Emergency/Pediatrics ward with signs and symptoms of sore throat were studied.

In this group, those children were included who presented with fever, pain in throat, cough, soreness of throat, anterior cervical lymphadenopathy, tonsillar enlargement, pharyngeal erythema, pharyngeal exudate, diffuse redness of tonsil and tonsillar pillar, petechial mottling of soft palate.

Detailed history and clinical examination was recorded on a planned proforma. Each case included in the study was subjected to following routine and specific investigations.

- Hb, TLC, DLC, ESR
- Urine examination (Routine, microscopic)
- ASO titre when needed

- Throat swab culture sensitivity
- Bacitracin sensitivity of  $\beta$ -hemolytic streptococcus
- Co-agglutination test for bacitracin sensitive isolates.

*Specimen collection for throat culture*

- Sterile cotton swabs were used for collection of throat specimens. The tonsils, anterior and posterior fauces and posterior pharyngeal wall were swabbed avoiding contact with the tongue and oral mucosa. The swabs were put in a sterile glass tube with cotton plug and transported to laboratory where the swabs were streaked on blood agar media containing 5-7% defibrinated sheep blood and incubated for 16-24 hrs at 37°C in candle extinction jars creating an atmosphere of 5-10% of carbondioxide. Growth of  $\beta$ -hemolytic streptococci, if any was subjected to bacitracin sensitivity (0.04units/disc)

Bacitracin sensitive isolates were further confirmed as group A using the principle of coagglutination with Meritec-strep  $\beta$ -hemolytic streptococcus group A grouping set.

### Coagglutination test

Principle of test : It is a rapid sensitive standardized coagglutination procedure for the identification of  $\beta$ -hemolytic streptococci based on serogroup described by Lancefield.

IgG specific for group A streptococcus is bound to killed staphylococcus aureus cell. This attachment is specific for the Fc fragment of antibody molecule. The Fab portion of this molecule is oriented such that it can react with its specific antigen. If antigen is added to antibody coated staphylococcus, they will bind specifically to Fab fragment resulting in formation of a visible coagglutination reaction. A red dye is incorporated to aid in visualization of the reaction.

Test procedure : A fresh (18-24 hrs)  $\beta$ -hemolytic (5% sheep blood agar) isolate of genus streptococcus was picked using a clean wooden applicator stick about size of end of applicator stick. It was rubbed evenly with gentle pressure about test oval on MERITEC disposable cards. Each reagent provided (streptococcal detection reagents) was re suspended by flicking the bottom of the vial. One drop of reagent was squeezed on test oval. Using small pieces of wooden applicator stick reagent drop was mixed with test drop. The disposable

card was rocked about its long axis  $45^\circ$  in each direction at rate of 30 cycles/minute. Most reaction were observed within 30 seconds.

The Group specific streptococcal detection reagent produced a visible coagglutination reaction which was due to the presence of streptococcal antigen at detectable level. When coagglutination was observed the culture was considered positive for the Group specific streptococci.

A clinical score card will be designed according to the criteria previously described by Breese. It will include two epidemiological factor (age, season) four clinical signs (erythema of pharynx, lymphadenopathy, pharyngeal exudate, size of tonsil) and three symptoms (fever, pain in throat, cough).

The score of each epidemiological and clinical factor will be obtained by taking the percentage of positive throat culture of each factor and dividing this percentage by ten and rounding it to the nearest digit.

All children having sore throat and GAS infection will be compared with those having negative throat culture. Sensitivity, specificity, positive predictive value, negative predictive value of signs

and symptoms and clinical score-groups will be calculated by standard methods.

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# OBSERVATIONS

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## ***OBSERVATIONS***

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The present study was conducted in the department of Pediatrics in collaboration with department of Microbiology, MLB Medical college, Jhansi from Dec 2002 to Nov 2003.

Signs and symptoms of 122 children who had complaints of cold and cough were recorded and throat swabs were collected after taking informed consent. Throat swabs were streaked on sheep blood agar media and growth of  $\beta$ -hemolytic streptococci if any, was subjected to bacitracin sensitivity (0.04 unit/disc). Bacitracin sensitive isolates were further confirmed as group A by coagglutination test.

**Table-I**

***AGE WISE DISTRIBUTION OF CASES***

<b>Age group</b>	<b>Number</b>	<b>Percentage</b>
5-8	89	72.95
9-12	33	27.05

Out of 122 cases under study, 72.95% were in the age group 5-8 years and 27.05% cases were in 9-12 years age group.

**Table -II*****SEX WISE DISTRIBUTION OF CASES***

Age (in years)	Boys		Girls	
	No.	%	No.	%
5-8	48	39.34	41	33.62
9-12	26	21.31	7	5.73
Total	74	60.65	48	39.35

The study group had male: female ratio of 1.54:1, however in 5-8 year age group this ratio was 1.17:1 and 9-12 years of age group, this ratio was 3.71:1.

**Table-III*****SEASON WISE DISTRIBUTION OF CASES***

Seasons	No.	Percentage
Aug- Jan	65	53.27
Feb – July	57	46.73

From August –January period there were 53.27% cases rest were in February to July period.

**Table – IV*****CLINICAL SYMPTOMATOLOGY IN STUDY GROUP***

<b>Clinical symptoms /sign</b>	<b>No.</b>	<b>Percentage</b>
Fever	72	59.01
Cough	81	66.39
Pain in throat	32	26.22
Watery nasal discharge	60	49.18
Mild erythema of pharynx	50	40.98
Severe erythema of pharynx	12	9.83
Non tender lymphadenopathy	63	51.63
Tender lymphadenopathy	29	23.77
Small tonsil	60	44.18
Moderate tonsil	48	34.34
Large tonsil	14	11.47
Pharyngeal exudates	12	9.83

Cough was the most common clinical symptom observed in cases under study. It was present in 81 patients (66.39%). Fever was seen in 72 cases (59.01%), watery nasal discharge was present in 60 cases (49.18%) while pain in throat was present in 32 cases (26.22%).

Among clinical signs non tender lymphadenopathy was present in 63 cases (51.63%), small tonsil in 60 cases (44.18%), mild erythema of pharynx in 50 cases (40.98%), moderate tonsils in 48 cases

(34.24%), tender lymphadenopathy in 29 cases (23.77%), large tonsils in 14 cases (11.47%) severe erythema of pharynx in 12 cases (9.83%) and pharyngeal exudates in 12 cases (9.83%).

**Table – V**

***RESULTS OF THROAT SWAB CULTURE, BACITRACIN  
SENSITIVITY AND CARD TEST***

Age	Total no.	GAS	Male	Female
5-8	89	16	7	9
9-12	33	12	6	6
Total	122	28	13	15

Out of 122 throats were GAS swabs 28(22.95%) were GAS culture positive. Of these 13 cases 46.42%) were males and 15 (53.58%) were females. Of the GAS culture positive cases 16 cases (57.14%) were in 5-8 years of age group while 12 cases (42.86%) in 9-12 years of age group. GAS culture positivity in 5-8 years age group was 17.97% and in 9-12 years age group was 36.36%. Among males positivity rate was 17.56% and female positivity was 31.25%.

**Table- VI*****SYMPTOMATOLOGY IN GAS POSITIVE CASES (28)***

Sign /symptom	No.	Percentage
Fever	20	71.42
Pain in throat	10	35.71
Cough	16	57.14
Erythema (mild+severe)	17	60.71
Mild pharyngeal erythema	14	50.00
Severe pharyngeal erythema	3	10.71
Lymphadenopathy	21	75.00
Non tender lymphadenopathy	10	35.71
Tender lymphadenopathy	11	39.28
Normal tonsil	11	39.28
Tonsillar enlargement	17	60.71
Moderate tonsil	12	42.85
Large tonsil	5	17.85
Pharyngeal exudates	2	7.14

Most common symptom in GAS positive cases in our study was fever 71.42%.

Cough was present in 57.14%, pain in throat in 35.71%, pharyngeal erythema in 60.71% (mild 50%, severe 10.71%) Moderate tonsil in 42.85%, tender lymphadenopathy in 39.28%, normal tonsil in 39.28%, non tender lymphadenopathy in 35.71% large tonsil in 17.85% pharyngeal exudates in 7.14% cases.

In the entire series when we consider 2 epidemiological factor age and season, 3 symptoms fever, cough and pain in throat and 4 signs erythema of pharynx, lymphadenopathy, tonsillar enlargement and pharyngeal exudates. It can be observed from table that the highest possible score is 30 and lowest is 18.

Gas positivity of each factor is obtained by taking number of GAS positive cases with that factor and dividing this by total number of cases with that factor. i.e. percentage of positive throat culture of each factor. The score of each factor is obtained by dividing this percentage by ten and rounding it to the nearest digit the score so obtained is shown in table -VII.

**Table- VII****CLINICAL SCORE CARD FOR DIAGNOSIS OF GROUP A****STREPTOCOCCAL SORE THROAT**

Epidemiological features/signs/symptoms		No. of cases in which factor is present	GAS positivity		score
			No.	%	
Age	5-8 years	89	16	17.97	2
	9-12 years	33	12	36.36	4
Seasons	Aug to Jan	65	17	26.15	3
	Feb to July	57	11	19.29	2
Fever	No	50	8	16.00	2
	Yes	72	20	27.77	3
Pain in throat	No	90	18	20.00	2
	Yes	32	10	31.25	3
Cough	No	41	12	29.26	3
	Yes	81	16	19.75	2
Erythema	No	60	11	18.33	2
	Mild	50	14	28.00	3
	Severe	12	3	25.00	3
Lymphadenopathy	No	30	7	23.33	2
	Non tender	63	10	15.87	2
	Tender	29	11	37.93	4
Size of tonsil	Normal	60	11	18.33	2
	Moderately enlarged	48	12	25.00	3
	Large	14	5	35.71	4
Pharyngeal exudates	No	116	26	22.41	2
	Yes	6	2	33.33	3

In our study pain in throat had highest GAS positivity 31.25% followed by fever 27.77% and cough 19.75%.

Among signs GAS positivity 37.93% with tender lymphadenopathy followed closely by large tonsil 35.71%, pharyngeal exudates 33.33%, mild erythema of pharynx 28%, severe erythema of pharynx 23.33%, erythema of pharynx (mild+severe) 27.41%, moderately large tonsil 25%, non tender lymphadenopathy 15.87%.

**Table- VIII**

***PREDICTIVE VALUE OF SYMPTOMS AND SIGNS FOR GAS***

***INFECTION***

Signs and symptoms		Sensitivity		Specificity		Predictive value			
						Positive		Negative	
		%	No/total	%	No/total	%	No/total	%	No/total
Fever		71.42	20/28	44.68	42/94	27.77	20/72	84.00	42/50
Pain in throat		35.71	10/28	76.59	72/94	31.25	10/32	80.00	72/90
Cough	No	42.85	42/28	69.14	65/94	29.26	12/41	80.24	65/81
	Yes	57.14	16/28	30.85	29/94	19.75	16/81	70.73	29/41
Erythema		60.71	17/28	52.12	49/94	27.41	17/62	81.03	49/60
Mild erythema		50.00	14/28	61.7	58/94	28.00	14/50	80.55	58/72
Severe erythema		10.71	3/28	89.36	84/94	25.00	3/12	77.06	84/109
Non tender lymphadenopathy		35.71	10/28	43.61	41/94	15.87	10/63	69.49	41/59
Tender lymphadenopathy		39.28	11/28	80.85	76/94	37.93	11/29	80.85	76/94
Tonsil (Moderate+large)		60.71	17/28	52.12	49/94	27.41	17/62	81.03	49/60
Normal tonsil		39.28	11/28	47.87	45/94	18.33	11/60	72.58	45/62
Moderate tonsil		42.85	12/28	61.70	58/94	25.00	12/48	78.37	58/74
Large tonsil		17.85	5/28	90.42	85/94	35.71	5/14	78.70	85/108
Pharyngeal exudates		7.14	2/28	95.74	90/94	33.33	2/6	77.58	90/116

Among various symptoms fever had highest sensitivity of 71.42% and negative predictive value 84.00%. Pharyngeal exudates

had highest specificity 95.74% and tender lymphadenopathy highest positive predictive value 37.93%. among various signs erythema of pharynx had highest sensitivity 60.71% and negative predictive value of 81.03%.

**Table – IX**

***FREQUENCY OF VARIOUS SCORES***

Scores	No. of pathogenic growth (94)	Streptococci (28)
18	7	3
19	8	3
20	13	2
21	20	2
22	12	2
23	18	2
24	5	4
25	6	3
26	4	3
27	1	4

On the whole most common score in our study is 21 but in GAS positive cases most common score are 24, 27.

**Table – X*****PREDICTIVE VALUE OF SCORES FOR DIAGNOSIS OF GAS SORE******THROAT***

27	TP 4	FP 1	SN 4/28 (14.28) + 4/5 (80)
	TN 93	FN 24	SP 93/94 (98.93) – 93/117 (79.48)
26	TP 7	FP 5	SN 7/28 (25) + 7/12 (58/33)
	TN 89	FN 21	SP 89/94 (94.68) – 89/111 (80.90)
25	TP 10	FP 11	SN 10/28 (35.71) + 10/21 (47.61)
	TN 83	FN 18	SP 83/94 (88/29) – 83/101 (82.17)
24	TP 14	FP 16	SN 14/28 (50) + 14/30 (46.66)
	TN 78	FN 14	SP 78/94 (82.97) – 78/92 (84.78)
23	TP 16	FP 34	SN 16/28 (57.14) + 16/50 (32.00)
	TN 60	FN 12	SP 60/94 (63.82) – 60/72 (83.33)
22	TP 18	FP 46	SN 18/22 (64.28) + 18/64 (28.12)
	TN 48	FN 10	SP 48/94 (51.06) – 48/58 (82.75)
21	TP 20	FP 66	SN 20/28 (71.42) + 20/86 (23.25)
	TN 28	FN 8	SP 28/94 (29.78) – 28/36 (77.77)
20	TP 22	FP 79	SN 22/28 (78.57) + 22/101 (21.78)
	TN 15	FN 6	SP 15/94 (15.95) – 15/21 (71.42)
19	TP 25	FP 87	SN 25/28 (89.28) + 25/112 (22.32)
	TN 7	FN 3	SP 7/94 (7.44) – 7/10 (70.00)

\*

TP = True positive  
 TN = True negative  
 SN = sensitivity  
 + = positive predictive value

FP = False positive  
 FN = False negative  
 SP = specificity  
 – = negative predictive value

Table- XI

*PREDICTIVE VALUE OF COMBINATION OF SIGNS AND  
SYMPTOMS*

**(a) Tender adenopathy with throat pain**

Total no. of cases =12

True positive =5                      False negative =23

False negative =7                      True negative =87

$$\text{Sensitivity} = \frac{5}{28} \times 100 = 17.85\%$$

$$\text{Specificity} = \frac{87}{94} \times 100 = 92.55\%$$

$$+ = \frac{5}{12} \times 100 = 41.66\%$$

$$- = \frac{87}{110} \times 100 = 79.09\%$$

**(b) Throat pain with large tonsil**

Total no. of cases =8

True positive =2                      False negative =26

False negative =6                      True negative =88

$$\text{Sensitivity} = \frac{2}{28} \times 100 = 7.14\%$$

$$\text{Specificity} = \frac{88}{94} \times 100 = 93.61\%$$

$$+ = \frac{2}{08} \times 100 = 25\%$$

$$- = \frac{88}{114} \times 100 = 77.19\%$$

**(c) Throat pain with erythema of pharynx**

Total no. of cases =24

True positive =5                      False negative =23

False negative =19                      True negative =75

$$\text{Sensitivity} = \frac{5}{28} \times 100 = 17.85\%$$

$$\text{Specificity} = \frac{75}{94} \times 100 = 79.78\%$$

$$+ = \frac{5}{19} \times 100 = 26.31\%$$

$$- = \frac{75}{98} \times 100 = 76.53\%$$

\* + positive predictive value

- negative predictive value

The above table shows the predictive values of various combination of signs and symptoms of streptococcal pharyngitis.

**Table - XII**

**COMPARISON OF PREDICTIVE VALUE OF COMBINATION OF  
SIGNS AND SYMPTOMS FOR THE DIAGNOSIS OF GROUP A**

**STREPTOCOCCAL SORE THROAT**

Signs and symptoms	Sensitivity		Specificity		Predictive value			
					Positive		Negative	
	%	No.	%	No.	%	No.	%	No.
Tender adenoapthy with throat pain	17.85	5/28	92.55	87/94	41.66	5/12	79.09	87/110
Throat pain with large tonsil	7.14	2/28	93.61	88/94	25.00	2/8	77.19	88/114
Erythema of pharynx with throat pain	17.85	5/28	79.78	75/94	26.31	5/19	76.53	75/98
Clinical score 24 or more	50.00	14/28	82.97	78/94	46.66	14/30	84.78	78/92
Clinical score 26 or more	25.00	7/28	94.68	89/94	58.33	7/12	80.90	89/110
Clinical score 27 or more	14.28	4/28	98.93	93/94	80.00	4/5	79.48	93/117

On considering combination of signs and symptoms their predictive values were inferior to clinical scores. Throat pain with large tonsil had specificity of 93.61% but sensitivity was very low 7.14% and positive predictive value was 25%. Similarly specificity of tender

adenopathy with throat pain was 92.55%, sensitivity was 17.85% and negative predictive value was 79.05%

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# DISCUSSION

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## DISCUSSION

Present study was conducted in the department of pediatrics, MLB Medical College, Jhansi. Acute pharyngitis is one of the most frequent illnesses for which pediatricians and other primary care clinics one physicians are consulted. Group A streptococcal pharyngitis is the only commonly occurring form of acute pharyngitis for which antibiotic therapy is definitely indicated, for prevention of suppurative complication and rheumatic fever or rheumatic heart disease. So appropriate diagnosis and treatment of GAS pharyngitis is important.

The study was aimed to diagnose GAS infection in hospital setting by history, clinical examination and confirming by culture and to validate the clinical and epidemiologic scoring system in hospital setting.

Out of 122 cases in our study (table-I) 89 cases (72.95%) were in 5-8 years of age group and 33 cases (27.05%) were in 9-12 years of age group. The study group had male (60.65%) female (39.35%) ratio of 1.54:1 (table-II). Of total cases 53.27% were studied in seasons August to January and 46.73% in February to July (table -III).

In the present study, cough was the most common symptom present in 66.39% cases, fever 59.01%, watery nasal discharge

49.18%, pain in throat 26.22% cases each. Non tender lymphadenopathy was present in 51.63%, small tonsil 44.18%, mild erythema of pharynx 40.98%, moderate tonsil 34.34% tender lymphadenopathy 23.77%, large tonsil 11.47%, severe erythema of pharynx 9.83% and pharyngeal exudates 9.83% cases each (table-IV).

All the cases were subjected to throat swabs culture on sheep blood agar media. Group of  $\beta$ -hemolytic streptococci, if any, was subjected to bacitracin sensitivity. Bacitracin sensitive isolates were further confirmed as group A by coagglutination test. Twenty eight out of 122 case were found to be group A  $\beta$ -hemolytic streptococcus positive (table-V). Thus incidence of GAS infection in study group was 22.95%.

Rotta J and Tikhomirov E (1987) in prospective studies disclosed that the incidence of streptococcal acute upper respiratory tract disease in temperate zones in 5-15 cases per 100 individuals per year.

Roos Kristian (1985) in their study found  $\beta$ -hemolytic streptococci in 63% case of acute tonsillitis of which 80% were group A and 20% group C and G streptococci.

Rosenstein BJ et al (1970) stated that a streptococcal etiology, usually group A has been found in between 25 and 70% of cases of pharyngitis. Sarkar et al (1998) in a study found that the point prevalence of group A streptococcal sore throat was 13.6% among rural school children in Varanasi.

Siegel et al (1961) studied 2545 children with pharyngitis and found that 47.7% of them were harboring beta hemolytic streptococci in their throats.

Nandi et al (2002) studied 536 children presenting with cold and cough and found GAS positivity rate of 13.4%.

Bisno AL (1996) reported that GABHS accounts for 15% to 20% or more of cases of acute pharyngitis in age group 5-15 years.

Dobbs F (1996) found group A  $\beta$ -hemolytic streptococci in 35% of 206 patients recruited with sore throat.

Among children of 2-16 years age presenting with sore throat Wald ER (1994) found throat culture positive for GAS in 48% cases.

Reed et al (1990) found group A  $\beta$ -hemolytic streptococci from 25.1% patients presenting with sore throat.

**Age distribution in culture positive cases**

Out of 122 cases included in our study, GAS culture positivity in 5-8 years age group was 17.9% and in 9-12 years age group was 36.36%. However, when GAS positive cases were analyzed it was found that 57.14% of them were in age group of 5-8 years and remaining in 9-12 years age group.

Bisno et al (1996) reported peak incidence of streptococcal pharyngitis in children aged 5-15 years.

Reed (1990) reported 39% of GABHS of culture positive children in  $\geq 9$  years age group and 21% children in 10-19 years age group.

Dobbs et al (1996) found 57% of children to be in age group 4-11 years in GABHS culture positive cases.

Wald et al (1994) in their study found 89% of GABHS culture positive children between 5-15 years of age.

#### **Sex Distribution in culture positive cases**

In our study 53.58% of culture positive cases were female and 46.42% were males. Among males positivity rate was 17.56% and females positivity was 31.25% (table-V).

Nandi et al 2002 observed that among males and females GAS positivity rate was 14.7% and 11.7% respectively. This was contrary to our study.

Reed Barbara D et al (1990) on there study on sore throat patients found 61% of culture positive cases to be females and 39% to be males.

### **Season wise distribution in culture positive case**

Among 28 GAS culture positive case 17 cases (60.71%) were in Aug to Jan season while 11 cases (39.28%) from February to July period GAS positivity rate among cases studied in Aug to January period was 26.15%, while Feb to July period was 19.29% (table-VII).

Nandi et al (2002) in there study also found higher GAS positivity rates in Aug to Jan period 15% as compared to Feb to July period which was 12%.

Dobbs et al (1990) found that 39% of GABHS were grown in seasons October to December i.e. autumn.

Breese et al (1977) found highest GAS positivity rate in seasons Feb to April, then Jan May Dec then June, Oct, Nov, then July Aug Sep.

### **Symptomatology in culture positive cases**

In our study among the culture positive cases, fever was the commonest presenting complaint 71.42%. There was cough without expectoration 57.14% cases and pain in throat 35.71% cases. None of the cases that were culture positive had watery nasal discharge (table-VI).

Reed et al (1990) in their study on sore throat patients found that among GAS culture positive cases fever was present in 65% of cases cough 47% cases moderate to severe sore throat 87% cases, achy joints 45% nausea 36%.

In study by Nandi et al (2002) most common symptom of GAS sore throat was pain in throat 86.2%, fever 34.1 watery nasal discharge 22%.

Dobbs F (1996) found very sore throat in 82% sore to swallow in 89% cases, rhinitis 18% ears sore 7%, cough 7%, abdominal pain 14%, vomiting 7%, headache 32% muscle aches 53% among the various symptoms in GAS culture positive cases.

Among various signs, erythema of pharynx was present in 60.71% (mild 50% and severe 10.71%), moderate tonsil 42.85%, tender lymphadenopathy 39.28%, normal tonsil 39.28%, non tender

lymphadenopathy 35.71%, large tonsil 17.85%, pharyngeal exudates 7.14%. GABHS culture positive cases (table-VI).

Reed et al (1990) found moderate or severe erythema in 77%, moderate to large tonsil in 55%, small tonsil in 45%, anterior or cervical adenopathy in 70% pharyngeal exudates in 38%, marked tender adenopathy in 15%, rash in 4% GABHS positive cases.

Nandi et al (2002) found erythema of pharynx in 92.7%, lymphadenopathy in 87%, enlarged tonsil in 86.9%, tender adenopathy in 64.2% GABHS positive cases.

Dobbs et al (1996) in GABHS positive cases found glands in 67% exudates in 44%, ulcerated red mount in 47%.

#### **Gas positive rates (%) for various signs and symptoms**

In our study pain in throat was symptom with highest GAS positivity 31.25%, fever 22.77% when cough was not present GAS positivity rate was 29.26%, while it was 19.75% when cough was present. Thus absence of cough had higher GAS positivity rate as compared to when cough was present (table-VII).

Nandi et al (2002) found GAS positivity rates for pain in throat 46.5%, fever 29.5%. Thus it was similar to our study in higher GAS positivity rate for pain in throat.

Breese et al (1977) found higher GAS positivity rate when cough was not present as compared to when cough was present. This observation was at par with our observation.

Among signs in our study decreasing order of GAS positivity was tender lymphadenopathy 37.93%, large tonsil 35.71%, pharyngeal exudates 33.33%, erythema of pharynx mild or severe 27.41%, mild erythema 28%, severe erythema 23.33% moderately enlarged tonsil 25% and non tender lymphadenopathy 15.87%.

Nandi et al (2002) in there study found 66.7%case with pharyngeal erythema be GAS positive. Similarly 66.7% case with pharyngeal exudates were GAS positive GAS positivity rate for large tonsil was 48.5%, non tender lymphadenopathy 37.7%, moderately large tonsil 28.4%.

**Predictive value of symptoms and signs for Group A streptococcal sore throat**

Of the 11 symptoms and signs tested on considering as first the symptoms fever had highest sensitivity of 71.42%, pain in throat 35.71% and cough 57.14% (table-VIII).

Nandi et al (2002) found 86.2% sensitivity for pain in throat, 55.3% for expectoration, 34.1% for fever, 22% for watery nasal discharge & 13.8% for hoarseness of voice

In our study among various symptoms specificity of pain in throat is 76.59%, fever 44.68% and absence of cough 69.14%.

In study by Nandi et al (2002) specificity of hoarseness of voice 91.9%, fever 87.7%, pain in throat 84.7%. Thus most sensitive symptom in our study is fever (71.42%) it has highest negative predictive value (84%), most specific is pain in throat (76.59%) and it has highest positive predictive value (31.25%) while Sobhan Nandi et al (2002) found highest sensitivity for pain in throat (86.2%), specificity for hoarseness of voice (91.9%) positive predictive value for pain in throat (46.5%) and negative predictive value for fever (89.6%).

Positive and negative predictive value of various symptoms in our study are pain in throat 31.25%, and 80% absence of cough 29.26% and 80.24%, fever 27.7% and 84% respectively.

Sobhan Nandi et al (2002) found positive and negative predictive value of pain in throat 46.5% and 67.1% fever 30% and 89.6%, hoarseness of voice 215 and 87.3% respectively.

In our study among various signs and sensitivity was lymphadenopathy 75%, erythema of pharynx 60.71% (mild 50, severe 10.71%), tender lymphadenopathy 39.28%, normal tonsil 39.28%, non tender lymphadenopathy 35.71%, large tonsil 17.85%, pharyngeal exudates 7.14%.

In our study specificity of pharyngeal exudates was 95.74% large tonsil 90.42%, tender lymphadenopathy 80.85% severe erythema 89.36% mild erythema 61.70%, moderate tonsil 61.7%, tonsillar enlarge 52.12%, lymphadenopathy 13.82%.

Sobhan Nandi et al (2002) found specificity of pharyngeal exudates was 97.9%, tender adenopathy 89.3%, lymphadenopathy 77.7%, tonsillar enlargement 69.1%, erythema of pharynx 63.4%.

Positive negative predictive values respectively of various sign in our study were tender lymphadenopathy 37.93% and 80.85%, large tonsil 35.71% and 78.7%, pharyngeal exudate 33.33% and 77.58% mild erythema 28% and 80.55%, mod tonsil 25% and 78.37%, lymphadenopathy 22.82% and 76.66%, severe erythema 25% and 77.06%, tonsillar enlargement 27.41 and 81.03%.

Sobhan Nandi et al (2002) found positive and negative predictive value of various sign as pharyngeal exudates 66.7% and 89.7%, tender adenopathy 48.2% and 94.2%, lymphadenopathy 37.7% and 97.5% and tonsillar enlargement 30.3% and 97.2%.

Thus in our study highest sensitivity was for lymphadenopathy 75% then pharyngeal (60.7%) erythema and tonsillar enlargement each, highest specificity for pharyngeal exudates (95.74%) positive

predictive value for tender adenopathy (37.93%) and negative predictive value for tonsillar enlargement and pharyngeal erythema 81.03%.

In study by Sobhan Nandi et al (2002) highest sensitivity (92.7%) and negative predictive value (98.2%) for erythema of pharynx, highest specificity (97.9%) and positive predictive value (66.7%) for pharyngeal exudates.

Kaplan et al and Wannamaker (1971) argue that enlarged cervical lymph nodes are positively related to streptococcal tonsillitis while Siegel et al (1961) tend to attach less importance to enlarged lymph nodes.

In our study we have obtained scores of various factor by dividing GAS positivity rate by 10 and rounding it to the nearest digit. Highest possible score on considering 9 factor (fever, age, season, cough pain throat, pharyngeal erythema, pharyngeal exudates, lymphadenopathy, tonsillar enlargement is 30 and lowest is 18. score of 4 has been obtained for large tonsil, tender lymphadenopathy and age group 9-12 years. Score of 3 are found for seasons Aug to Jan, fever, pain in throat, absence of cough, mild and severe erythema each, moderately enlarged tonsil and pharyngeal exudates. Score of 2 are for

age group 5-8 years seasons Feb-July, absence of fever, absence of pain in throat, absence of erythema of pharynx, presence of cough, non tender lymphadenopathy or no lymphadenopathy, normal tonsil and absence of pharyngeal exudates (table-VII).

Nandi et al (2002) designed a score card for early diagnosis of GAS sore throat with maximum possible score of 36 and minimum 4. Score of 7 had been given to pharyngeal exudates and severe pharyngeal erythema.

Score of 5 had been given to pain in throat tender lymphadenopathy, large tonsil score of 3 had been given to moderate tonsil, mild erythema of pharynx, fever. Score of 2 had been give to age group 9-12 years, seasons Aug to Jan. Score of 1 to 5-8 years age group, seasons Feb to July, absence of fever, absence of pharyngeal exudates. 0 score had been given to no throat pain, no lymphadenopathy, normal tonsil and no erythema of pharynx.

**Score card (Nandi et al 2002)**

Epidemiological features signs/symptoms		Gas positivity (%)	Score
Age	5-8 years	12.7	1
	9-12 years	15.0	2
	13-15 years	11.2	1
Seasons	Aug to Jan	15.0	2
	Feb to July	12.0	1
Fever	No	10.5	1
	Yes	29.5	3
Erythema of pharynx	No	1.8	0
	Mild	26.4	3
	Severe	66.7	7
Size of tonsil	Normal	2.8	0
	Moderately enlarged	28.4	3
	Large	48.5	5
Pharyngeal exudate	No	10.3	1
	Yes	66.7	7
Lymph adenopathy	No	2.5	0
	Without tenderness	37.7	4
	With tenderness	48.2	5
Pain in throat	No	2.5	0
	Yes	46.5	5

Breese BB (1977) in there nine item score card included nine factors month in which the patients is seen, age, WBC count, fever, sore-throat, cough, headache, abnormal pharynx, abnormal cervical

lymph nodes. For these none factors the highest score possible is 38 and the lowest 14. Score of 4 was given to fever  $100.5^{\circ}$  or more, sore throat, no cough, headache, abnormal pharynx abnormal cervical glands, age of 5 years, 10 years, months February March, April. Score of 3 had been given to age 4,11,12,13,14 year, month Jan, May, Dec, WBC count 10.5-13.4. Score of 2 had been given to June Oct, Nov. WBC count 8.5-10.4, age 3 years, 15 years. Score of 1 had been given to age 2 years or less month July Aug, Sept, WBC count 0-8.4.

**Breese score card (1977)**

Seasons of year		Fever $\geq 100.5^{\circ}\text{F}$	
Feb – April	4	Yes	4
Dec-Jan May	3	No	2
June Oct Nov	2	Sore throat	
July Sept	1	Yes	4
Age Years		No	2
5-10	4	Cough	
4,11,14	3	Yes	2
$3 \geq 15$	2	No	4
$< 2$	1	Headache	
WBC /mm <sup>3</sup>		Yes	4
$< 8400$	1	No	2
8500-10400	2	Abnormal pharyngitis	
10500-13400	3	Yes	4
13500-20400	5	No	1
$> 20500$	6	Unknown	3
Not done	3	Abnormal cervical glands	
		Yes	4
		No	2
		Unknown	3

Wald ER (1994) assigned a streptococcal score on the basis of a point scheme, in which the features were (1) age (2) seasons (3) temperature of at least 38.3°C (4) >1cm or tender adenopathy (5) pharyngeal erythema, edema or exudates and (6) no symptoms of a viral upper respiratory infection (conjunctivitis, rhinorrhea, or cough). Each item was given a score of 1. In there study only 14.6% of patients had all classical features of streptococcal infection, although 48% of children evaluated had a positive throat culture. Score ranged from 2 to 6; the most common score was 5. They concluded that the score can be used to predict the likelihood that a throat culture will be positive for GAS and it was not intended to supplant specific diagnostic testing. A score of 6 had a positive predictive value of 75%; 22.8% of patients with a score of 2 or 3 also had a positive throat culture for GAS. They said that as there is no correlation between the severity of acute infection with GAS and the likelihood of developing acute rheumatic fever, it is potentially hazardous to omit performance of a throat culture in patients with low streptococcal scores.

**(Wald et al 1994) streptococcal clinical score**

Age 5-15 years	1
Season November –May	1
Fever >38.3°C	1
Adenopathy	1
Pharyngitis	1
No upper respiratory symptoms	1

Reed et al 1990 calculated clinical scores by the method described by Breese and concluded that scores can not replace culture in the diagnosis of group A  $\beta$ -hemolytic streptococci.

In our study most common score was 21. Among GAS positive cases most common score were 24 and 27. in the highest score group the sensitivity was very low and in the lowest score group specificity was low.

In this study score of  $\geq 24$  has sensitivity 50%, specificity 82.97% positive predictive value of 46.66% and negative predictive value of 84.78%. score of  $\geq 25$  has sensitivity of 35.71%, specificity of 87.23%, positive predictive value 47.61%, negative predictive value of 82%. Score of  $\geq 26$  has sensitivity of 25% specificity of 87.23% positive predictive value of 58.33% and negative predictive value of 80.90%.

Score of 27 has sensitivity of 14.28% specificity 98.93%, positive predictive value 80% and negative predictive value 79.48%.

On considering individual signs and symptom specificity of pharyngeal exudates is 95.74%, but its sensitivity 7.14% and negative predictive value 77.58% are low.

Sensitivity of mild pharyngeal erythema is 50% but its specificity is very low 61.7%. Similarly sensitivity of fever is 71.42, but its specificity is 44.6% low large tonsil had specificity of 90.42% but its sensitivity was low 17.85% and positive predictive value was only 35.71%. Of tender lymphadenopathy specificity was 80.55% and sensitivity was 39.28%.

On considering combination of signs and symptoms their predictive values were inferior to clinical scores. Throat pain with large tonsil had specificity of 93.61% but sensitivity was very low 7.14% and positive predictive value was 25%. Similarly specificity of tender adenopathy with throat pain was 92.55%, sensitivity was 17.85% and negative predictive value was 79.05% (table-XII).

Thus predictive value of scores are comparatively superior to individual signs and symptoms as well as combination of sign and symptoms. In study by Nandi et al (2002) clinical score of 15 or more

had sensitivity of 91%, specificity 85%, positive predictive value of 48.5% and negative predictive value of 98.4%.

The scoring system by Breese showed 83% sensitivity, 72% specificity and both positive and negative value of 78% scoring system by Dobbs F (1996) had a sensitivity of 74% as well as a specificity of 71%. Scoring system of Reed BD (1990) had a sensitivity of 26% specificity of 94% and a negative predictive value of 79%.

Wald et al (1994) proposed a 6 point scheme with positive predictive value of 59% for a score of 5 and 75% for score of 6.

#### Accuracy of throat culture

Only about 1 patient in 10 with GABHS in the upper respiratory tract would be missed if a single throat culture were performed (Gerber 1989). Moffet et al (1964) found that only 11 of 30% patients (3.6%) with negative throat cultures and no antibiotic therapy had a significant rise in ASO titre suggesting that few bonafide GABHS infections had been missed by a single throat culture.

Radetsky (1985) suggested sensitivity and specificity of 95% for scoring system to replace culture altogether.

In our study the positive predictive value of a score of 24 is 46.66% score of 25 is 47.61% and a score of 26 is 58.33%. Therefore it

is insufficient for preventing unnecessary treatment prior to culture results. Use of this scoring system will lead to over treatment with antibiotics in about 53.33% and 41.77% respectively for score of 24, 25, 26 respectively i.e. it will treat those not having GAS pharyngitis.

In our study of 24 will fail to identify 50% of these with GABHS in pharynx, score of 25 % will not identify 65% with GABHS, score of 26 will not identify 75% of those with GABHS. Score of 27 will fail to identify 85% of those with GABHS in pharynx but it will result in less over treatment because of its greater specificity (98.93%), only 20% of those not having GAS pharyngitis will be treated, as a score of 27 has positive predictive value of 80%.

In comparison as Dobbs et al (1996) stated that unaided general practitioner can predict streptococcal infection with a sensitivity of 61% and a specificity of 65%.

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# SUMMARY

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## *SUMMARY*

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The present study was conducted in the department of Pediatrics in collaboration with Department of Microbiology, MLB Medical College, Jhansi over one year period.

Signs and symptoms of 122 children who had complaints of cold and cough were recorded and their throat swabs were collected after taking informed consent. Throat swabs were streaked on sheep blood agar media and growth of  $\beta$ -hemolytic streptococci, if any, was subjected to bacitracin sensitivity. Bacitracin sensitive isolates were further confirmed as group A by coagglutination test.

The prime objective of the study was to find out the incidence of group A streptococcal infection in children with various signs and symptoms of sore throat and to validate a clinical and epidemiological score card for diagnosis of group A streptococcal infection.

- The incidence of GAS infection in the study group was 22.95%.
- When GAS positive cases were analysed it was found that 57.14% of them were in age group of 5-8 years and 42.86% in 9-12 years age group.
- Aug to Jan was the period in which 60.71% of GAS positive cases occurred while it was only 39.28% from February to July.

- In our study 53.58% of culture positive cases were female while rest were male.
- Common symptoms in GAS culture positive patients were fever 71.42%, cough 57.14%, pain in throat 35.71% of cases.
- None of GAS positive cases had watery nasal discharge.
- Among signs most common were erythema of pharynx and tonsillar enlargement in 60.71% each, tender adenopathy in 39.28%, while pharyngeal exudates in only 7.14% of cases.
- Mild erythema of pharynx was seen in 50% cases and severe in 10.71%, moderate tonsils were present in 42.85% cases while large tonsils in 17.85% cases.
- Every sign and symptom was analysed for GAS positivity. Pain in throat was the symptom with highest association with GAS infection i.e. in 31.25%, fever in 22.7% and absence of cough in 29.26% cases.
- Among signs tender lymphadenopathy was associated with GAS infection in 37.93% cases. For large tonsils GAS positivity rate was 35.71%, for pharyngeal exudates it was 33.33%, for erythema of pharynx 27.41%, while for moderately enlarged tonsils it was 25% and only 15.87% for non tender lymphadenopathy.

- Of 11 symptoms and signs tested fever had highest sensitivity (71.42%) and negative predictive value (84%), while most specific was pain in throat (76.59%) and it had highest positive predictive value.
- Among major signs highest sensitivity was for pharyngeal erythema and tonsillar enlargement 60.71% each, highest specificity for pharyngeal exudate 95.75%.
- Tender adenopathy had highest positive predictive value 37.93% and highest negative predictive value was for tonsillar enlargement and pharyngeal erythema 81.03% each.
- Score i.e. weightages of various signs and symptoms that can predict GAS infection had been assigned as described by Breese (1977). Scores of various factors had been obtained by dividing GAS positivity rate of each factor by 10 and rounding it off to the nearest digit. On considering 9 factors (2 epidemiological factors seasons and age, 3 symptoms fever pain in throat and cough, 4 signs pharyngeal erythema pharyngeal exudates lymphadenopathy and tonsillar enlargement) possible lowest score was 18 and highest was 30.

- Among GAS positive cases most common scores were 24 and 27 while in GAS negative cases were 21.
- Predictive value of scores varied in the highest and lowest score group. In the highest score group sensitivity was very low and in the lowest score group specificity was less.
- Score of  $\geq 24$  had sensitivity of 50% specificity of 82.97% positive predictive value of 46.66% and negative predictive value of 84.78%.
- Score of  $\geq 25$  had sensitivity of 35.71% specificity of 87.23% positive predictive value of 47.61% and negative predictive value of 82%.
- Score of  $\geq 26$  had sensitivity of 25% specificity of 87.23% positive predictive value 58.33% and negative predictive value of 80.90%.
- Score of  $\geq 27$  had sensitivity of 14.28% specificity of 98.92% positive predictive value of 80% and negative predictive value of 79.48%.
- These values were found to be superior to individual sign and symptoms as well as combination.

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# CONCLUSION

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## CONCLUSION

- The incidence of group A streptococcal infection in children 5-12 years age group presenting with signs and symptoms of cold and cough in our hospital setting was 22.95%.
- Although majority of GAS sore throat patients were in age group 5-8 years (57.14%) remaining were in 9-12 years age group, GAS was isolated twice more often in 9-12 year age group.
- There was female preponderance, ratio of female : male being 1.15:1. Also GAS positivity rates were 1.77 times higher in females.
- About 61% cases were recorded from Aug to Jan period of the year.
- Fever ( $> 38.3^{\circ}\text{C}$ ) was the most common symptom found in 71.46% of cases.
- Cough (57.14%) and pain in throat (35.71%) were next most common symptoms.
- Erythema of pharynx and tonsillar enlargement were most common signs (60.71%).
- Tender adenopathy was second most common sign (39.28%).

- *Pain in throat was the most specific symptom, its specificity being 76.59%.*
- *A clear rhinorrhea can predict non streptococcal infection.*
- *Absence of cough was 1.5 times more commonly associated with GAS infection rather than its presence.*
- *Most specific signs of GAS sore throat were pharyngeal exudates 95.74%, large tonsils 90.42%, severe erythema of pharynx 89.36% and tender adenopathy 80.85%.*
- *Pain in throat was the symptom and tender adenopathy was the sign with highest GAS positivity rates.*
- *Our 9 factor scoring system included 2 epidemiological factors (age, seasons) 3 symptoms (fever, cough, pain in throat) and four clinical signs (pharyngeal erythema, pharyngeal exudates, tonsillar enlargement and lymphadenopathy).*
- *Application of cut off score of  $\geq 24$  had sensitivity of 50%, specificity of 82.97%, positive predictive value of 46.66% and negative predictive value of 84.78%.*
- *Application of cut off score of  $\geq 27$  had sensitivity of 14.28%, specificity of 98.93%, positive predictive value of 80.00% and negative predictive value of 79.48%.*

- There are limitations to diagnostic accuracy of this scoring system. The score of 27 will result in less over treatment because of its greater specificity but will fail to identify 85% of those with GABHS in pharynx.
- Sensitivity and specificity are inversely related. Since only a minority of patients with streptococcal infection present with classical symptoms and because other infections of throat can mimic clinical presentation of streptococcal infection, *conventional throat culture remains the gold standard for diagnosis of group A streptococcal sore throat. We can use this scoring system as a supplant to throat culture for diagnosis of GAS infection.*

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## *BIBLIOGRAPHY*

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# *WORKING PROFORMA*

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- Icterus
- Clubbing
- Cyanosis
- Oedema
- Lymphadenopathy : Tender or non tender
  - Esp. Anterior cervical and submandibular
- Oral cavity
  - Tonsils
  - Anterior pillar
  - Posterior pillar
  - Soft palate
  - Posterior pharyngeal wall
- Blood pressure
- Systemic examination
  - Gastro intestinal system
  - Cardiovascular system
  - Central nervous system
  - Respiratory system

### INVESTIGATION

- Hb
- TLC
- DLC
- ESR
- Urine routine microscopic
- ASO titre when needed
- Throat swab culture
- Bacitracin sensitivity
- Card test (co-agglutination test)

## WORKING PROFORMA FOR STUDY

TOPIC:    *Clinical score card for diagnosis of group A streptococcal sore throat*

Case No.

Date

Name of patient

Age & Sex

Address

MRD No.

### **HISTORY**

#### **Presenting complaints**

- Fever
- Sore throat
- Pain in throat
- Cough
- Watery nasal discharge

#### **Past history**

- Antibiotic use
- Sore throat

#### **Developmental history**

#### **Dietary history**

#### **Family history**

### **EXAMINATION**

#### **General Examination**

- General condition
- Heart rate
- Respiratory rate
- Temperature
- Hydration
- Pallor

- Icterus
- Clubbing
- Cyanosis
- Oedema
- Lymphadenopathy : Tender or non tender
  - Esp. Anterior cervical & submandibular
- Oral cavity
  - Tonsils
  - Anterior pillar
  - Posterior pillar
  - Soft palate
  - Posterior pharyngeal wall
- Blood pressure
- Systemic examination
  - Gastro intestinal system
  - Cardiovascular system
  - Central nervous system
  - Respiratory system

### INVESTIGATION

- Hb
- TLC
- DLC
- ESR
- Urine routine microscopic
- ASO titre when needed
- Throat swab culture
- Bacitracin sensitivity
- Card test (co-agglutination test)